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Reviewing, Reforming, and Rethinking Global Energy Subsidies: Towards a Political Economy Research Agenda

Benjamin K. Sovacool¹²

¹ Corresponding Author, Professor of Business and Social Sciences and Director of the Center for Energy Technologies, Department of Business Development and Technology, Aarhus University, Birk Centerpark 15, DK-7400 Herning, Denmark
Email: BenjaminSo@hih.au.dk Tel: +45 3032 4303

² Professor of Energy Policy, Science Policy Research Unit (SPRU), School of Business, Management, and Economics, University of Sussex, United Kingdom

Abstract: This article provides a review of global energy subsidies—of definitions and estimation techniques, their type and scope, their drawbacks, and effective ways to reform them. Based on an assessment of both policy reports and peer-reviewed studies, this article presents evidence that energy subsidies could reach into the trillions of dollars each year. It also highlights how most subsidies appear to offer net costs to society, rather than benefits, in the form of government deficits, increased waste, shortages of energy fuels, and aggravated environmental impacts, among others. The review then talks about how tools such as best practices in measurement and estimation, subsidy elimination, impact studies, and adjustment packages can dramatically reorient subsidies so that they become more socially and environmentally sustainable. It also argues that such efforts need to explicitly learn from previous successes and recognize the importance of political economy, the possible winners and losers to subsidy reform. The final part proposes a future research agenda.

Keywords: subsidy reform; energy policy; subsidies; subsidy

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Introduction

Energy subsidies have emerged to become one of the most polemic, pervasive, and political energy policy tools. On the one hand, their often-stated justification is that subsidies help target public resources into neglected areas of infrastructure and development; can spur much-needed innovation; and/or are instrumental at achieving various social or technological goals.^{1 2} Some energy subsidies, notably low-income assistance to poor households under the Low Income Home Energy Assistance Program or Weatherization Assistance Program in the United States³, or the Warm Front Program in the UK⁴, have served a valuable social mission. Others, such as those supporting the early efforts of the Rural Electrification Administration⁵, were essential in the expansion of what was at that time a new and novel technology, the electricity grid. Despite many implementation problems, subsidized energy does provide an important social safety net across the Middle East and Africa.⁶ For instance, in South Africa subsidies for Liquefied Petroleum Gas stoves have been key to the rapid adoption of more sustainable, less carbon-intensive cooking practices that also save households money.⁷

On the other hand, many subsidies serve almost no discernible public good—and in some ways, they can do considerable bad.⁸ When addressing the Organization of Economic Cooperation and Development (OECD), Kiyo Akasaka, Deputy Secretary General, went so far as to argue that “Subsidies often introduce economic, environmental, and social distortions with unintended consequences. They are expensive for governments and may not achieve their objectives while also inducing harmful environmental and social outcomes.”⁹ More recently, Secretary-General of the OECD Angel Gurría impassionately argued that “We need strong,

credible and predictable climate policies, in particular a price on carbon and the elimination of both consumer and producer subsidies that support incumbent fossil fuels. These are, in climate terms, ‘sins of commission’ for which there is no excuse.”¹⁰ Energy subsidies, moreover, are increasingly becoming parts of costly and protracted trade disputes, creating friction between countries. One study found that energy subsidies were behind 14.5% of the trade disputes handled by the World Trade Organization between 2010 and 2013.¹¹

This article provides a global review of energy subsidies (primarily but not exclusively those for fossil fuels and nuclear power). It assesses the type and scope of subsidies, how they are defined and measured, their drawbacks, effective ways to reform them, and future research questions. Based on an assessment of both policy reports and peer-reviewed studies, this article presents evidence that energy subsidies could reach into the trillions of dollars each year. It also highlights how most subsidies appear to offer net costs to society, rather than benefits, in the form of government deficits, increased waste, shortages of energy fuels, crime associated with illicit fuel trade, and aggravated environmental impacts, among others. The final parts of the review also discuss various policy reform efforts as well as associated political economy implications and future research questions.

Defining subsidies and understanding estimation techniques

To begin, defining an energy subsidy can be fraught with difficulty. The World Trade Organization defines a subsidy as “a financial contribution by a government, or agent of a government, that confers a benefit on its recipients.”¹² The United Nations and International Energy Agency define an energy subsidy as “any measure that keeps prices for consumers below market levels, or for producers above market levels, or that reduces costs for consumers and producers”¹³ The Global Subsidies Initiative and the International Institute for Sustainable

Development add that subsidies can do this in complex ways. They can directly or indirectly transfer liabilities, forgo government revenue, provide goods or services below market value, or offer direct income or price support for a preferred technology.¹⁴ As Table 1 reveals, at least 17 different types of energy subsidies are on the books for many countries around the world, and most of these were oriented towards lowering the cost of energy production, though others did focus on raising prices and still others lowering prices for users.^{15 16 17 18}

Table 1: Typology of Global Energy Subsidies

<i>Type of subsidy</i>	<i>Example(s)</i>	<i>How it Works</i>		
		Lowers cost of production	Raises price to disfavored producer	Lowers price to consumer
<i>Direct financial transfer</i>	Grants to producers	X		
	Grants to consumers			X
	Low-interest or preferential loans	X		
<i>Preferential tax treatment</i>	Rebates or exemptions on royalties, sales taxes, producer levies and tariffs	X		
	Investment tax credits	X		X
	Production tax credits	X		
	Accelerated depreciation	X		
	State sponsored loan guarantees	X		
<i>Trade restrictions</i>	Quotas, technical restrictions, and trade embargoes		X	
	Import duties and tariffs		X	
<i>Energy-related services provided by</i>	Direct investment in	X		

serve” customers.¹⁹ Because they are indirect and hidden, these types of subsidies rarely “count” in official government audits and documents.

Therefore, analysts have developed various methodologies and estimation techniques to try and grapple with the scope and extent of energy subsidies. Generally, as Table 2 summarizes, four approaches exist. The simplest and most common is an estimation of government support (including forgone revenue such as tax credits, or accounting for only direct expenditure). Many countries attempt to release such data, usually annually or every few years, often through ministries or departments such as the U.S. Energy Information Administration, U.S. Government Accountability office, or the Danish Energy Agency.

Table 2: Overview of four subsidy measurement approaches

Approach	Description	Strengths	Limitations	Institutional examples
Program-specific estimation	Quantifies value of specific government programs to particular industries; aggregates programs into overall level of support	Captures transfers whether or not they affect markets	Does not address questions of ultimate incidence or pricing distortions	Various government ministries and departments
Price-gap	Evaluates positive or negative “gaps” between the domestic price of energy and the delivered price of energy of comparable products from abroad	Can be estimated with more limited data, good indicator of pricing or trade distortions	Sensitive to assumptions regarding market prices, undertakes full value of subsidies because it ignores transfers that may not effect markets	International Energy Agency
Inventory (producer support estimate /	Systematic method to aggregate	Attempts to capture a more holistic	Data intensive, and empirical data for many	OECD

consumer support estimate)	transfer plus market supports to particular industries	measurement of support, can reveal separate effects on producer and consumer markets	markets remains limited	
Externalities	Assesses the full social cost of subsidies including normally un-priced effects external to the market place	Tries to measure not only holistic measurement of subsidy support but broader social, environmental, and economic impacts	Many externalities difficult to monetize, also data-intensive and prone to very large estimates	International Monetary Fund

Source: Modified from Koplow, D. and Dernbach, J. (2001). Federal fossil fuel subsidies and greenhouse gas emissions: A case study of increasing transparency for fiscal policy. *Annual Review of Energy and the Environment* 26, 361–389; as well as Masami Kojima and Doug Koplow, *Fossil Fuel Subsidies: Approaches and Valuation*, World Bank Group Policy Research Working Paper 7220, March, 2015.

The “price-gap” approach calculates the difference between the reference price for energy in an actual or imputed market-based transaction and the price actually paid by, or officially charged to, an end user (usually a residential, commercial, or industrial customer) for that same energy delivered to the same location at the same time. The International Energy Agency utilizes this approach, and it often determines positive gaps on the assumption that if energy is sold at a price below what it would have been in a competitive, deregulated market, the explanation for the lower price must be some government intervention. This usually takes the form of a subsidy, a cross-subsidy, or some form of price regulation including an export tax or restriction.²⁰

The “inventory approach” attempts to list policies using different subsidy-delivery mechanisms in a catalogue, seeking to document and quantify a wide range of government interventions in energy markets, utilizing a mix of support delivery mechanisms. The goal of an inventory approach is twofold: to help government officials and citizens understand the overall

scale of public spending and policies promoting particular energy pathways, and to help identify the most important leverage points for reform. An inventory ideally encompasses all direct expenditures by the government, forgone revenues due to targeted tax and other fiscal concessions, and other forms of support such as below-market provision of credit and insurance, as well as market transfers to or from consumers and/or producers. Analysts commonly utilize producer support estimate (PSE) and consumer support estimate (CSE) techniques to meet this task.²¹

A fourth and final type of estimation technique attempts to draw from any of the earlier approaches and then adds in the cost of un-internalized (and often unintended) externalities. There are divergent views on how to deal with externalities, ranging from not counting them as subsidies to classifying all externalities associated with fuel production or consumption as fuel subsidies. As we will see below, inclusion or exclusion of subsidies can account for a variance of \$500 billion to more than \$5 trillion in valuation of global fossil fuel subsidies. Currently, the IEA and the OECD consider such externalities to be outside the scope of subsidy measurement, whereas the IMF includes the cost of consumption-related externalities in its “post-tax” subsidy estimations, counting as subsidies failure to charge for the economic damage caused. The underlying assumption is externalities are a form of damage cost that should have been captured in the price of the fuel.

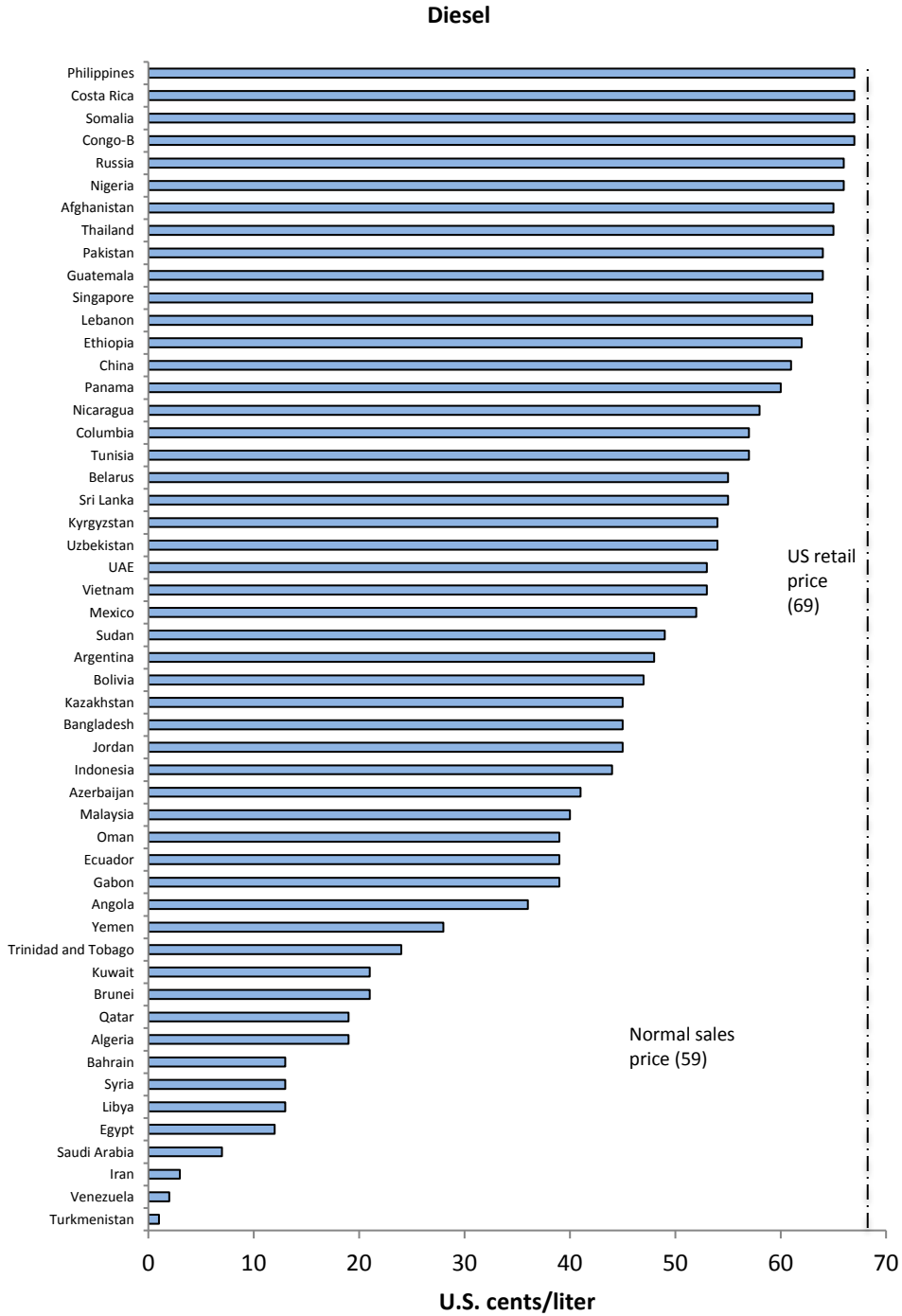
Estimating Global Energy Subsidy Expenditures

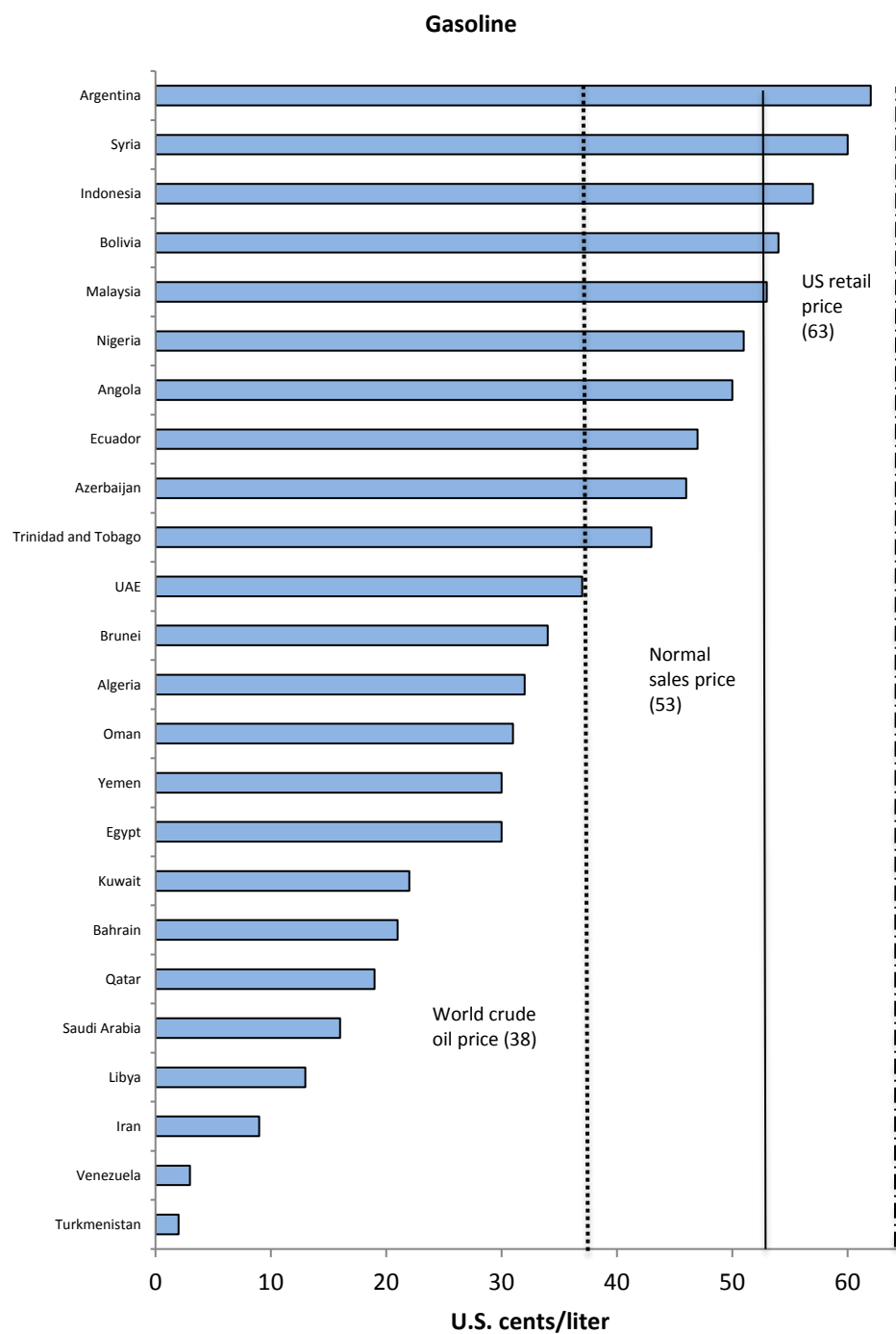
With these differences in definitions and valuation in mind, practically every energy system has been subsidized at some point. Oil wells were given free licenses in the 1860s. Coalmines received tax breaks in the 1880s and 1890s. Natural gas turbines benefited from military research on jet engines and rocket boosters. Solar panels received some of their earliest

support from NASA for their ability to provide electricity in outer space. Nuclear power has long been backed by steep contributions from the defense industry and benefited tremendously from the shifting of long-tail risks (waste management and accident risks primarily) from the investor onto the taxpayer.²² Even today, renewable energy sources such as wind turbines and geothermal power plants receive tax credits in many countries; coal receives special tax treatment and black-lung benefits paid by government in countries as diverse as China, Russia, and the United States; oil and gas receives huge tax shelters as well as research subsidies.^{23 24}

Because of this complexity and rich history, many different estimates and projections of the amount of subsidies exist. One international survey of 171 countries, using the price-gap approach, found that in 29 nations, refined gasoline and diesel prices were lower per unit than the international price of crude oil and below the minimum retail level in competitive markets in 52 additional countries—implying the existence of significant subsidies.²⁵ Figure 1 shows some of the results of this survey. An extreme example of such subsidies is Venezuela, where the price for gasoline was a mere 6 cents per gallon (or 1.6 cents per liter)—less than one fiftieth of what somebody in California pays—perhaps explaining why gasoline consumption there is 40 percent greater than any other Latin American country and three times the average for the region.²⁶

Figure 1: Subsidies for Gasoline and Diesel in Selected Countries





Source: Redrawn from Trevor Morgan, *Energy Subsidies: Their Magnitude, How They Affect Energy Investment and Greenhouse Gas Emissions, and Prospects for Reform* (Geneva: UNFCCC Secretariat Financial and Technical Support Programme, June 2007).

The International Energy Agency has been tracking energy subsidies through an online database and estimated in 2014 that “fossil-fuel consumption subsidies” totaled, using a price gap approach, about \$493 billion.²⁷ As they summarize in Table 3, subsidies are extremely high in particular countries, with Algeria, Iran, Kuwait, Saudi Arabia, and Venezuela all seeing rates above 70%. In Iran in particular, the IEA reports that energy subsidies accounted for roughly one-fifth of national Gross Domestic Product.

Table 3: Energy Subsidization Rates per capita and per GDP for selected countries, 2014

Country	Average subsidization rate (%)	Subsidy per capita (\$/person)	Total subsidy as share of GDP (%)
Algeria	77.8	524	9.4
Angola	39.0	110	1.9
Argentina	33.5	326	2.5
Azerbaijan	23.6	154	2.0
Bahrain	59.9	1697	6.7
Bangladesh	25.8	19	1.7
Bolivia	43.6	177	5.6
Brunei	45.6	900	2.5
China	2.2	13	0.2
Chinese Taipei	0.5	7	0.0
Colombia	0.0	0	0.0
Ecuador	49.2	350	5.6
Egypt	54.7	276	8.0
El Salvador	21.1	71	1.8
Gabon	7.0	36	0.4
Ghana	0.4	1	0.0
India	16.8	30	1.9
Indonesia	31.4	110	3.1
Iran	82.0	994	19.3
Iraq	53.7	360	5.6
Kazakhstan	31.9	309	2.5
Korea	0.2	4	0.0
Kuwait	81.4	2528	5.1
Libya	77.9	1188	18.0
Malaysia	14.6	175	1.6
Mexico	5.2	42	0.4
Nigeria	25.4	28	0.9

Oman	63.6	1775	9.0
Pakistan	21.0	37	2.7
Qatar	68.8	2754	3.0
Russia	19.6	277	2.1
Saudi Arabia	78.6	2428	9.5
Sri Lanka	7.1	16	0.5
Thailand	4.2	31	0.6
Trinidad and Tobago	37.0	770	3.6
Turkmenistan	68.4	1474	16.3
UAE	55.2	1868	4.4
Ukraine	21.9	142	4.9
Uzbekistan	58.8	293	14.3
Venezuela	93.1	1017	15.2
Vietnam	4.0	11	0.5

Source: Modified from International Energy Agency, “Energy Subsidies,” 2014, available at <http://www.worldenergyoutlook.org/resources/energysubsidies/>. Note: Average subsidization rate is calculated as the subsidy/reference price of the fuel.

Though difficult to estimate across all sectors (not just fossil fuels) for all countries, another review from 1999 calculated that energy subsidies amounted to 21.1 percent of all energy prices, in essence subsidizing roughly one-fifth of global consumption.²⁸ They calculated that subsidies for fossil fuels and energy exceeded \$331 billion in 2000 and that subsidies for road transportation amounted to \$1,180 billion—a total of \$1.5 trillion, or \$1.9 trillion updated to today’s dollars. Although their methods have been subject to critique, the authors mused that these subsidies, among other things, made gasoline cheaper than bottled water.

The numbers from Myers and Kent may sound high, but even estimates of subsidies using very different methodologies have reached similar findings. A study from the International Center for Technology Assessment calculated global energy subsidies at between \$627.2 billion to \$1.9 trillion in 2004.²⁹ More recently, the International Monetary Fund (IMF) projected in 2013, using an externalities approach, that fossil fuel subsidies amounted to \$1.9 trillion on a “post-tax basis” globally, equivalent to 8 percent of all government revenue for that year.³⁰ They

updated their figures in 2015 to put the amount at \$5.3 trillion, or 6.5% of global GDP, with the largest subsidies in absolute terms in China (\$2.3 trillion), the United States (\$699 billion), and Russia (\$335 billion).³¹ If the estimates that energy-related subsidies amounting to more than \$1 trillion per year are accurate, then they are equivalent to the GDP of all low-income countries in the world per year.³²

The fiscal, social, and environmental cost of subsidies

Despite their pervasiveness, such subsidies cultivate a long list of negative social and environmental impacts, including larger budget deficits for governments, artificially increased waste and reduced efficiency, energy shortages and the exacerbation of poverty, and inflated greenhouse gas emissions.

Government deficits

The most obvious impact is that subsidies create larger budget deficits and higher taxes, diverting funds from potentially better options for fiscal support and programs such as healthcare and education. In India, a study from the World Institute of Sustainable Energy looked at 19 coal-fired, natural gas, and hydroelectric power plants and calculated that cumulative subsidies amounted to 150 percent the cost of the original investment—meaning the subsidies enabled the industry to operate at a collective loss to taxpayers and Indian society.³³ It is telling in India that fuel subsidies for kerosene and liquid propane gas are of the same magnitude as those for education.³⁴ Lam et al. more recently determined kerosene subsidies to amount to \$200–950 million, even higher than these earlier projections.³⁵ Similarly, in countries such as Egypt, Jordan, and Yemen, energy subsidies represent government expenditures far greater than those directed at health and education.³⁶

In the United States, subsidies have enabled some industries to operate at a net cumulative loss, operating as a drain on public resources. Typical examples here are the hidden costs subsumed by ratepayers associated with nuclear power plants³⁷ and uranium enrichment facilities.^{38 39} Subsidies also contribute to smuggling and therefore additional losses of tax revenue: Tunisians consume cheaper (illegal) fuel from Algeria, Yemeni oil is smuggled into Djibouti, and black market Nigerian fuel is illicitly distributed into many West African countries.⁴⁰

As a crude but admittedly effective thought experiment, consider what these billions (and possibly trillions) of dollars could otherwise be spent on. Independent of where the money would go, every incremental reduction of a country's debt strengthens their local currency, decreases inflation, increases employment, and decreases the amount of interest on foreign loans—and in the United States, the federal government spends \$197 billion per year on such interest alone, an amount expected to rise to \$800 billion by 2020.⁴¹ Furthermore, the United Nations projects that \$19 billion dollars per year is enough for a campaign to eliminate global hunger and malnutrition; \$12 billion per year, enough for reproductive health care for all women; \$10 billion per year enough for clean drinking water for all; \$5 billion per year for universal literacy; \$1.3 billion per year for immunizing every child.⁴² Even if the UN estimates turn out to be too low, the potential social gains from subsidy reform could be enormous. One statistic bears repeating: if the world's potential \$1.9 trillion in energy subsidies were repealed tomorrow, that would provide enough money to eliminate worldwide hunger and malnutrition one *hundred* times over. (Reasons as to why such countries do not always reform such subsidies are given later in the paper). To those who may find these numbers hyperbole, consider that government

spending on fossil-fuel subsidies is already close to that of the level of development aid from the OECD to the whole world.⁴³

Increased waste and reduced efficiency

Generally, subsidies to consumers result in lower end-user prices and increased consumption. This applies even in globally-competitive markets such as oil – with the caveat that subsidized supplies may be diverted into black markets and therefore not available to the poor. Producer subsidies in protected markets, due to either interventions or challenges moving natural gas or evacuating electricity, work similarly, reducing end-user prices. Producer subsidies to fuels that are broadly traded on global markets (e.g., oil or to some degree coal) tend to affect the structure of supply by keeping inefficient producers alive. These can be one coal plant vs another; or coal vs. cleaner replacement fuels. Most of the time, market prices do not materially drop in these cases. Therefore, depending on the type of subsidy, most generally increase levels of consumption far beyond where they would otherwise be. By lowering the end price of energy, subsidies therefore lead to higher energy use, and they also reduce the economically rational incentives to properly maintain or meter energy systems and products.

For example, in the former Soviet Union district heating was often provided far below cost—sometimes free—leading people to “waste” heat in a variety of ways, including keeping windows open in the winter and growing tropical flowers inside.^{44 45} According to the IEA, Iran spends an annual \$66 billion or 20 percent of the country’s GDP in energy subsidies, mostly oil, to keep prices low. Their purpose is to buy off the populace (similar to bread and circuses in Roman times), and in some cases to deliver some semblance of a social safety net in a country with governments unable to use more sophisticated lump sum transfers that flow only to the targeted population subgroup. A side effect is higher consumption. Saudi Arabia, Venezuela,

and Egypt each also provided oil subsidies of \$10-\$20 billion in that same year.⁴⁶ Oil subsidies are even offered in China (\$24 billion) and India (\$13 billion), major oil-importing nations, despite the fact that they encourage excessive consumption that requires more imports.⁴⁷

India subsidizes total fossil energy consumption by \$21 billion or some \$16 per person every year—a substantial amount given that 500 million of its people live on less than \$2 per day. In India, subsidies for electricity encourage so much waste that the United Nations calculated that removing them would cut demand by 34 percent,⁴⁸ though the political economy of this statistic is interesting. India also has a very high unmet demand for reliable electric power, but is plagued with corruption such that power utilities are unable to properly collect bills or adjust tariffs. Thus, there might be a situation where in addition to higher tariffs driving some of the very poor to disconnect because of affordability, the ability for the utility to provide more reliable and expansive power services to the less-poor population results in higher demand despite higher prices.

In China, subsidies were found to distort prices for coal by an average of 9.9%, with average distortions among household prices reported at 24.4% for transport fuels and 11.8% for electricity consumption.⁴⁹ In countries belonging to the Gulf Cooperation Council in particular—Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates—subsidies have led to lower real energy prices, making cheap energy available in turn leading to excessive consumption.⁵⁰

Additionally, subsidies, by generally manipulating the cost of energy, also erode motivations to promote energy efficiency or to conserve energy. Subsidies on coal production in Europe, for example, hamper efforts to improve productivity and capture methane from empty coalmines. In the United Kingdom, coal subsidies have slowed the transition to better, safer

mines and also discouraged producers from developing better coal pollution equipment. In the Czech Republic and Slovak Republic, subsidies have held back innovation in the oil and gas sectors. Guaranteed profits mean operators tend not to invest in upgrades or, at times, maintenance. Similarly, in Russia, the large subsidies for district heating mentioned above meant that operators had no incentives to fix leaking steam pipes, did not improve their metering and billing practices, and did not invest in insulation and better building envelopes, leading to “extreme” inefficiency.⁵¹ In the Middle East, governments such as Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates are so heavily dependent on oil subsidies that they need at least \$80 per barrel to provide public services and cross-subsidize their economies—and some, such as Saudi Arabia, encountered budget deficits in 2014. This contrasts with private companies and multinational oil companies such as ExxonMobil and British Petroleum that can reputedly turn a profit with oil at \$20 per barrel, because they need concern themselves only with oil field profitability.^{52 53}

In other situations, subsidies seem to have little effect at all on energy trends—implying that they are a poor value for money. The U.S. Energy Information Administration conducted an in-depth exploration of energy subsidies in the United States, and noted two salient trends.⁵⁴ First, the level of subsidies has actually grown considerably over the period examined; the EIA estimated that direct energy subsidies *doubled* from 1999 to 2007 and indirect tax expenditures have *tripled* over the same period. Second, and oddly, the EIA concluded that the subsidies did not really have an impact given global trends. They had no net result on energy production, which the EIA called “virtually unchanged.” Part of the explanation might be that this is because some types of subsidies cancel others out—some, say, encourage energy efficiency, convincing customers to save energy, whereas others encourage production and lower prices, convincing

customers to use more energy. They certainly helped particular industries, but resulted in no net change for the country.

Energy shortages and poverty

Counterintuitively, and perhaps even ironically, subsidies intended to help the poor can cause energy shortages and, in some cases, increase poverty. Caps and ceilings on prices clearing particular market levels have frequently led to physical shortages of energy (such as that of natural gas in the 1970s and 1980s in the United States⁵⁵) and, at times, government rationing programs. In India, crude oil and oil products are strictly rationed for precisely these reasons, and the below-market price delivery of small liquefied petroleum gas cylinders has led to “large distortions” in prices and shortages among some 42 million households.⁵⁶ Similarly, in Myanmar, fixed prices for electricity, diesel, and gasoline have resulted in shortages when those prices fall below international market levels—convincing suppliers to focus on exports to China and Thailand rather than domestic use, and also stripping them of needed revenues to maintain and expand their utility infrastructure.^{57 58}

Subsidies for some fuels such as kerosene, liquefied petroleum gas, natural gas, and electricity can worsen levels and intensities of poverty. In many developing countries, modern energy carriers are subsidized for an apparent purpose of improving household living conditions by making energy more affordable. However, Arze del Granado et al. (2012) documented that across 20 developing countries, subsidies were in fact regressive.⁵⁹ Poorer households consumed a disproportionately smaller fraction of the total fuel and electricity supply, and households in the top income quintile spent nearly 20 times more (per capita) on most energy services. The study calculated that the bottom income quintile received on average about 7% of the overall subsidy benefit, whereas the richest quintile received on average almost 43%. A

review by Lockwood similarly found that only 20 percent of the shares of subsidies received globally ended up benefitting the poor, and that in India, of the \$22.5 billion spent on fossil fuel subsidies in 2010, less than \$2 billion benefitted the poorest 20 percent of the population.⁶⁰

In concert with these findings, the United Nations warns that instead most of these subsidies benefit energy companies, equipment suppliers, and wealthier households in towns and cities; *not* the urban poor and *not* communities living in rural villages. As a result, “many energy-subsidy programs intended to boost poor households’ purchasing power or rural communities’ access to modern energy through lower prices can, paradoxically, leave the poor worse off, since the costs are shared by the entire population including the poor.”⁶¹ The explanation is that poorest households are often unable to afford even subsidized energy, and that the poor have lower consumption levels, meaning on a per-unit basis subsidies benefit those with higher incomes.

Externalities and emissions

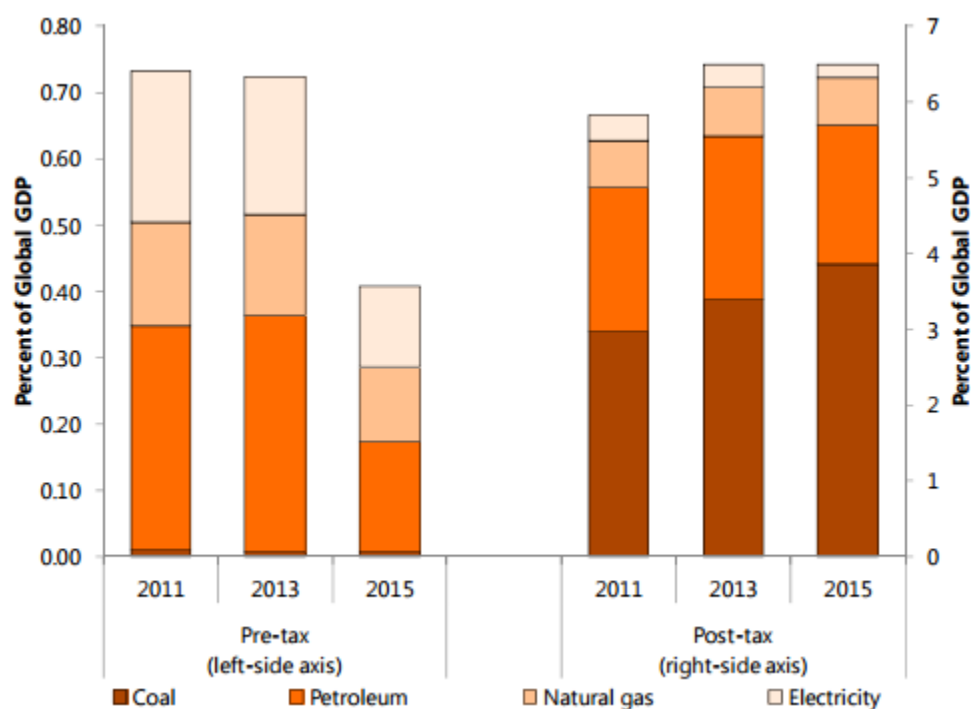
Because the bulk of energy subsidies still go towards environmentally damaging fossil fuels or environmentally deleterious aspects of the nuclear energy fuel cycle, they also produce more externalities and contribute to climate change.

Looking closely at the numbers in the United States, conventional sources have received almost 90 percent of all energy subsidies from 1943 to 1999.⁶² In 1973, before the energy crisis, the federal government awarded 93 percent of its subsidies to fossil energy but only 6 percent to energy efficiency, renewable electricity, and other non-nuclear alternatives. Even in fiscal year 1979, when subsidies for renewable energy peaked at \$1.5 billion, subsidies for fossil fuels were greater at \$1.9 billion and more than 58 percent of the DOE research budget was directed at nuclear power.⁶³ Another longitudinal study of U.S. energy subsidies, one going all the back to

the 1800s, estimated that nuclear subsidies amounted to more than 1 percent of the entire federal budget, that oil and gas subsidies made up one-half to 1 percent of the total budget, but that support for cleaner systems such as renewables and energy efficiency have constituted only one tenth of one percent.⁶⁴ More recently, the GAO noted that during the early 2000s that fossil energy received 86 percent of government subsidies, nuclear energy 8 percent, and renewables and energy efficiency only 6 percent.⁶⁵ Thus, government policymakers remained heavily committed to supporting conventional sources for much of the previous decades.

Subsidies heavily favoring fossil fuels and conventional energy exist around the world, not just in the United States. When disaggregated by technology, as Figure 2 illustrates with IMF data, coal remains the largest single source of post-tax subsidies, reaching 3.9% of global GDP in 2015, followed by petroleum, which reached 1.8% of global GDP despite falling prices.⁶⁶

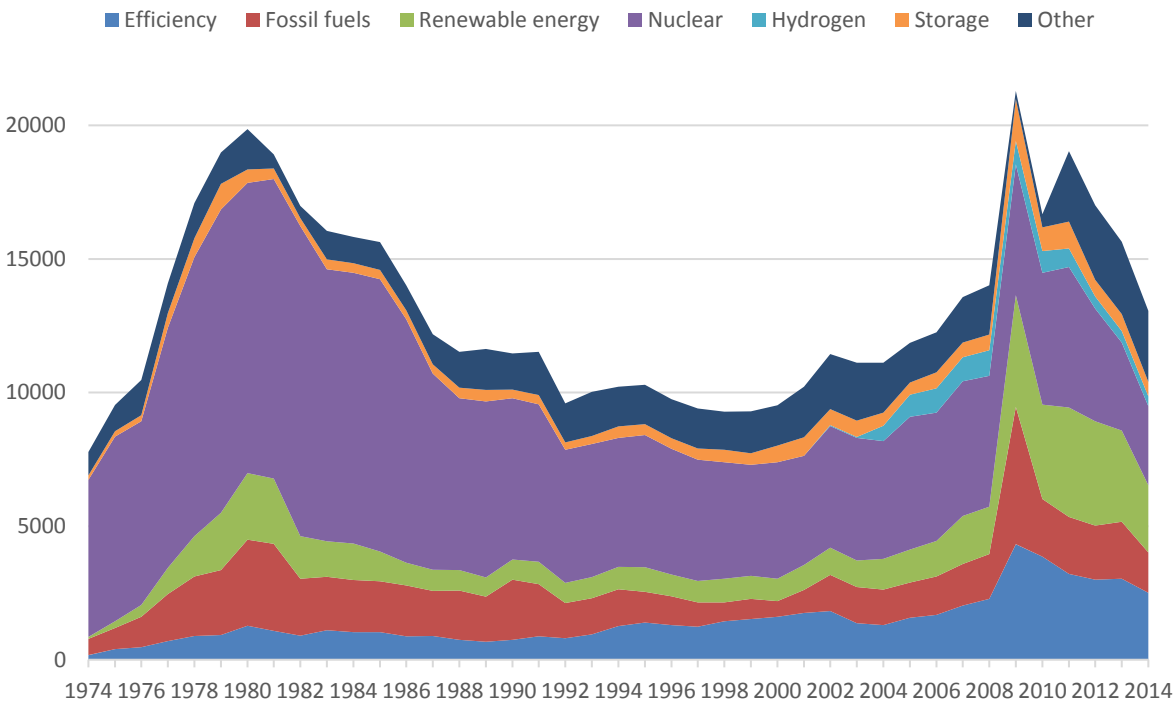
Figure 2: International Monetary Fund Estimate of Global Energy Subsidies by Product, 2011–15



Source: David Coady, Ian Parry, Louis Sears, and Baoping Shang, *How Large Are Global Energy Subsidies?*, IMF Working paper WP/15/105, May, 2015, available at <http://www.imf.org/external/pubs/ft/wp/2015/wp15105.pdf>

The International Institute for Sustainable Development similarly estimated that three-quarters of energy subsidies go towards conventional systems such as fossil fuels and nuclear power.⁶⁷ In the OECD as a whole, the bulk of research subsidies also goes (again) towards fossil fuels and nuclear power. Technologies and processes such as Generation IV nuclear reactors, combined cycle natural gas turbines and clean coal technologies such as carbon sequestration, fluidized gas combustion, and integrated coal gasification combined cycle systems have received about \$331 billion dollars in research funds from industrialized countries, almost three times the \$130 billion spent on the entire class of renewables, numbers reflected in Figure 3.⁶⁸

Figure 3: Global Energy Research Expenditures in the Organization of Economic Cooperation and Development, 1974-2014 (Millions of U.S. Dollars)



Source: Data compiled from International Energy Agency website, accessed February 2016.

Thus, because of this favoritism towards fossil fuel, energy subsidies have substantial carbon footprints. As just one example, subsidies for coal in the European Union and Japan are responsible for 50 to 100 million extra tons of carbon dioxide emissions per year.⁶⁹ In Australia, cheap subsidies for coal-fired electricity have resulted in a smelting industry that produces 2.5 times as many greenhouse gas emissions per ton of manufactured aluminum as the world average,⁷⁰ in addition to whatever distortions flow through the economies of Australia's Asian importers. The World Bank has estimated that the removal of subsidies for oil, coal, and natural gas would immediately reduce global greenhouse gas emissions by 9 percent⁷¹—more than any single national source of annual emissions except for China and the United States. The IMF similarly calculated in 2013 that fossil fuel subsidies result in an extra 4.5 *billion* tons of carbon dioxide emissions from additional energy consumption.⁷² Another estimate calculated that

between 1980 and 2010, more than one-third (36%) of global carbon emissions were driven by fossil fuel subsidies.⁷³

Subsidy “lock-in,” “traps,” and “addiction”

Importantly, subsidies become self-replicating because, once enacted, they continue to shape energy choices through the long-lived infrastructure and capital stock they create. This justifies further expenditures to operate, maintain, and improve existing technologies. Coal and nuclear plants built 40 years ago, for example, still receive subsidies for coal mining and uranium enrichment.⁷⁴ One study referred to this as the energy subsidy “trap:” once a government begins subsidizing, such efforts become protected and defended by beneficiaries.⁷⁵

Subsidies also have a degree of infectiousness, given that once one country starts subsidizing a particular energy fuel or system, others are motivated to respond with their own subsidies to compete. The federal government in the United States subsidizes fossil fuels so much that among the 30 industrialized nations forming the Organization for Economic Cooperation and Development (OECD)—including the EU, Japan, Australia, and Korea—it is responsible for 70 percent of all subsidies for coal worldwide (when externalities are not included).⁷⁶ This subsidization creates higher demand for fossil fuel imports globally, forcing other countries to subsidize their own energy sectors.⁷⁷ Subsidies in this way create something very close to addiction.⁷⁸ Governments initially favor dispensation of privileges in exchange for political support, but grow more dependent on that support over time.

This trend of subsidy “lock-in” and “dependency” is nicely illustrated with an example of subsidies for crude oil in developing countries. In 2004, crude oil prices climbed to historic highs, increasing in price sevenfold only to lose all of their previous gains over the preceding five years in a few months. The World Bank assessed the responses of 49 developing countries

to these oil price increases, with a sample of governments spread across Africa, Asia, Latin America, and the Middle East.⁷⁹ The Bank study found that many governments resorted to subsidies in the face of rising prices in an attempt to keep consumers protected. These new subsidies included credits for the exploration and production of oil, tax reductions, agricultural subsidies, discounts for passenger transport, price controls for fuel for fisheries, and partial compensation for domestic refineries. China, India, and Mexico alone had \$67 billion worth of these new subsidies. However, the study noted that when prices for oil receded, the subsidies remained: powerful constituencies had become dependent on them, and consumers resented the option of suddenly paying more for energy. The implication is that enacting subsidies is far easier than scaling them back.

Suggestions for policy reform and political economy

Clearly, we need to reform and rethink our approach to subsidies. As the IMF underscores in their data, more than $\frac{3}{4}$ of the underpricing or subsidization of energy is due to domestic distortions such as pre-tax subsidies and domestic pricing regimes, rather than global issues such as climate change.⁸⁰ This suggests that national policymakers hold incredible sway over the scope and duration of their subsidies. This section of the paper considers multiple policy options for reform: best practices in measurement, subsidy repeal, impact studies, adjustment packages, learning from previous successes, and appreciating the overarching salience of political economy.

Adopting best practices in subsidy measurement

Best practices in subsidy measurement and estimation exist, and they offer useful guidance for independent analysts and governments. Subsidy data and analysis should be transparent, complete, and comparable, and calculations both relatively easy to carry out and

replicable.⁸¹ Kojima and Koplow emphasize that best practice in subsidy estimation and aggregation methods usually adhere to the following characteristics:

- **Consistency across estimators.** Both within a country and internationally, subsidy measurement results should reflect the policies in place, regardless of who is doing the estimation;
- **Consistency across sectors.** Cross-sectoral comparison requires meticulous attention to detail to ensure that the same methods are applied despite substantially and even qualitatively different market conditions, sector structure, and key policy questions;
- **Transparency about assumptions, baselines, and boundaries.** Part of ensuring this consistency is for assumptions on key inputs and boundaries to be clearly stated. This should include information about the data sources, timing, and required adjustments for reference price calculations;
- **Aggregation:** Being able to combine data elements in a consistent manner enables an analysis of broader patterns;
- **Data availability at different levels.** Examining data on a more granular level if possible, be it by geographic region, beneficiaries (by fuel type, industry, consumer or producer), type of support mechanism, or other attributes, can lead to more nuanced analysis;
- **Consistency and availability over time.** Subsidy estimates change from year to year as the economic and policy environment shifts. World energy prices, government policy, energy extraction or consumption rates, and a variety of other factors all affect the magnitude of subsidies. A tracking system needs to provide consistent data over a sufficient period in order to provide the necessary base for subsidy analysis and reform;

- **Provision of estimation range.** While budgetary transfers can usually be measured precisely, many other types of subsidies cannot. Estimate variance can be considerable, and it is useful visualize ranges in the reported calculations. Such disclosure can also help prioritize the areas in which analytical work can improve estimation accuracy.

In addition, three other aspects can complement these best practices: mixed methods approaches, peer-review, and sunset clauses:

- **Recognize complementary methods.** Many of the techniques mentioned above—price-gap, inventory, and externality approaches—tend to be used independently from each other. However, these methods are often complementary and should be used more together. Differences in valuation can also reveal underlying assumptions and make transparent data gaps;
- **Conduct subsidy peer-review.** Voluntary, bottom-up, cross-country peer reviews of subsidies have already begun to lead to improvements in valuation and legitimacy. China and the United States started in 2016 a cross-departmental, cross-sector peer review of fossil fuel subsidies through a group of experts. They will systematically examine the state of subsidies, undertaken with the aim of building a long-term domestic energy and subsidy strategy. In 2014 and 2015, New Zealand and Peru similarly reviewed each other's fossil fuel subsidies, leading to increased awareness about their impacts.⁸²
- **Sunset clauses.** The insertion of sunset clauses into regulation can set an explicit expiration date and prevents subsidies from operating indefinitely. It also gives stakeholders a clear expectation about when a subsidy would end, reducing the risk of dependency and lock-in.⁸³ The United Kingdom placed a sunset clause on their reintroduction of coal subsidies in 2000—intended to bolster the competitiveness of the

mining industry—explicitly stating that those subsidies would expire in 2002. Similar sunset clauses and explicit expiration dates have existed for production tax credits for both nuclear power and renewable energy, for better or for worse, in the United States, implemented under the Energy Policy Acts of 1992 and 2005. Sunset provisions could also be an early step towards complete elimination of such support.

Eliminating inappropriate subsidies

Elimination of subsidies could be complete, meaning a government would abolish every type of subsidy, across the board. A second variant would be more targeted, removing subsidies only for “conventional,” “dirty,” or “undesirable” energy systems such as oil, coal, natural gas, and possibly nuclear power. A third variant would be to remove “perverse subsidies.” These are subsidies that harm both the economy and the environment. Examples include those that:

- Maintain production processes that would otherwise be uneconomic, such as subsidies to grow corn for ethanol in arid areas;
- Produce un-usable surpluses, such as the “lakes” of butter, milk, and wheat commonly discarded in the 1980s;
- Deter efforts at environmental sustainability, such as subsidies for the harvesting of old-growth forests for heating fuel instead of a shift towards forest management, afforestation, or reforestation;
- Stimulate activity that degrade natural resources underpinning agriculture and economic growth, such as subsidies for electric irrigation systems in places that otherwise should not grow crops.⁸⁴

Removing all, some, or only the most “perverse” subsidies has the potential alter energy markets for the better. Myers and Kent estimated (many years ago) that the removal of “perverse”

subsidies would immediately cut energy consumption by 3.5 percent and reduce emissions by 4.6 percent per year, and also increase global welfare by \$35 billion and increase real income for the world by 0.7 percent.⁸⁵ Another group of economists calculated that by merely cutting fuel subsidies for gasoline by 80 percent, global demand for oil would immediately drop by 5 percent—the equivalent of removing 2.5 million barrels of oil a day from the market (at that time).⁸⁶

Although they vary based on their methods, assumptions, and scope, we see similar consensus among more recent studies suggesting that subsidy removal will significantly cut greenhouse gas emissions. The International Energy Agency's estimates suggest that the removal of subsidies for energy consumption in a group of eight developing economies would reduce energy use by 13 percent, reduce carbon dioxide emissions 16 percent, and raise incomes by 1 percent in aggregate.⁸⁷ The IMF correspondingly estimated that removing fossil fuel subsidies would cut global emissions of carbon dioxide, and other health-damaging pollutants such as sulfur dioxide, by 13 percent.⁸⁸ Merrill et al. compiled a list of almost a dozen separate studies all showing greenhouse gas emissions reductions from subsidy removal to range from 6.4 percent to 13 percent globally and from 1.3 percent to 9.3 percent for countries such as China, India, Indonesia, and Thailand.⁸⁹ Their results are summarized in Table 4.

Table 4: Estimated Greenhouse Gas Emissions Reductions associated with Subsidy Removal

Name	Year	Scope country	Scope Fuel	Comments on modeled	Emission reduction	Methodology
International Energy Agency	2014	Global	Consumer Fossil- fuel subsidies (FFS), IEA data	IEA recommends in order to keep the rise in temperature below 2°C is the “further partial phase out of FFS to end-consumers” (part of the 4-for-2°C scenario). IEA calculates that this package of measures will account for 80 per cent of the GHG emissions reduction that is necessary to achieve the 2degree goal, equivalent to a reduction of 3.1Gt of carbon dioxide equivalent.	360 Mt carbon dioxide equivalent will be the reduction of the implementation of the 4-for-2°C scenario	World Energy Model
Asian Development Bank	2014	India	Petroleum (diesel, liquid petroleum gas [LPG], kerosene), electricity, Coal	For all models and projections in the ADB report, assumptions were made in terms of GDP growth, population growth and fossil-fuel price growth.	1.8 per cent (MARKAL) and 1.3 per cent (E3MG) by 2030	MARKAL and E3MG
Asian Development Bank	2014	Indonesia	Petroleum (gasoline, diesel, LPG, kerosene), electricity	Emissions savings come from lower demand for energy and a change in energy mix.	5.1 per cent (MARKAL) and 9.3 per cent (E3MG) by 2030	MARKAL and E3MG

Asian Development Bank	2014	Thailand	Diesel, LPG, natural gas (vehicles), electricity	Emissions savings come from lower demand for energy and a change in energy mix.	2.8 per cent (MARKAL) by 2025	MARKAL
Burniaux & Chateau	2011, 2014	37 non-OECD countries+ Korea + Mexico	FFS consumer, IEA data	Covers 37 countries (covering 95 per cent of globalized fossil-fuel consumption). If subsidies are removed gradually between 2013 and 2020 in the countries of which the data was modelled.	Global GHG emissions of an 8 per cent reduction by 2050	OECD ENV-Linkages General Equilibrium model
Lin & Ouyang	2014	China	Coal, oil, gas, electricity consumer subsidies. Price gap approach	IEA price gap approach, calculation of subsidies for the period 2006–2010. Price elasticity of different fuels in China based on econometric models.	3.72 per cent carbon dioxide emission reduction (based on Partial Equilibrium Model). Significant carbon dioxide and sulfur dioxide emission reductions	Partial Equilibrium Model and computable general equilibrium (CGE) model
Schwanitz et al.	2014	Global	IEA data	Different scenarios on climate policy dimension and the degree of phasing-out fossil-fuel subsidies are being modelled	6.4 per cent GHG emission reductions in the Zero2020 scenario by 2050	REMIND (intertemporal energy–economy model)

International Monetary Fund	2013	Global	Petroleum, natural gas, coal,	Assumptions in the model include one price elasticity per fossil fuel, one carbon dioxide coefficient per unit fossil fuel. carbon dioxide, sulphur dioxide and local pollutants emission reductions based on reduced consumption and the carbon dioxide coefficient.	13 per cent decrease in carbon dioxide emissions (4.5 billion tons); reduction of 10 million tons of SO ₂ ; further 13 per cent reduction in other local pollutants.	IMF Model for carbon dioxide, SO ₂ and local pollutants' emission reductions
APEC Energy Working Group	2012	APEC	FFS consumer, IEA data for APEC region	Study refers back to OECD and IEA model: Phase out results in carbon dioxide emission reduction of 4.7 per cent by 2020 and 5.8 per cent by 2035	Phase-out results in carbon dioxide emission reduction of 10 per cent by 2050 globally. Reduction in Russia and Eastern European countries would be up to 20 per cent and have	OECD – IEA models
OECD	2011	Global	FFS consumer, IEA 2008 data (incl. input for electricity)	Phasing out FFS consumer subsidies in developing and emerging countries can lead to global reduction of GHG emissions of 6 per cent	6 per cent global reduction by 2050 20 per cent reduction in Russia and MENA countries	ENV-Linkages model
Anderson & McKibbin	2000	Global	Coal	Phase-out of coal subsidies (production and consumption) in OECD and non-OECD	8 per cent reduction in carbon dioxide emissions	CGE Model

Stefanski	2014	Global	Emissions intensity	Comparison of emissions intensities to GDP and historical development over time to understand if distortions are linked to the presence of fossil-fuel subsidies	Model finds far larger and indirect subsidies to fossil fuels of around \$983 billion in 2010. 36 per cent of global carbon emissions between 1980 and 2010 were driven by subsidies and that GDP was up to 1.7 per cent lower per year because of the distortive	A model of structural to the experiences of the UK.
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Source: Modified from Laura Merrill, Melissa Harris, Liesbeth Casier, and Andrea M. Bassi, Fossil Fuel Subsidies and Climate Change, Options for policy makers within their Intended Nationally Determined Contributions, Nordic Working Papers, 2015. Note: FFS = fossil fuel subsidy.

Conducting subsidy impact studies

Rather than fully repealing subsidies, governments and communities could conduct subsidy impact studies to better determine the costs and benefits of particular subsidies, and which ones could be revised or repealed. As the United Nations Environment Program has suggested, making on-budget costs transparent and properly accounted for can enhance public dialogue and even inform policymakers of hidden subsidies.⁹⁰ Such subsidy studies, apart from revealing financial flows, could include standardized ways of defining subsidies, tracking them and publishing data about them, and creating an international framework of independent monitors to continuously evaluate them.⁹¹ Subsidy impact studies could even be published visibly in places such as the *Federal Register* in the United States, where they would be subject to public commenting.⁹² Such studies may show that rather than removing subsidies entirely, they instead need tweaked: perhaps given to households or poor customers themselves, rather

through intermediaries such as oil and gas companies or utilities, or shifted from dirtier or less efficient energy systems to cleaner and more efficient ones.

As a positive sign, many efforts are already underway to conduct more rigorous studies about subsidy impacts. At the 2009 Pittsburgh G-20 summit, the leaders of the twenty largest developed and developing nations agreed to “phase out and rationalize over the medium term inefficient fossil fuel subsidies while providing targeted support to the poorest.”⁹³ As a complement to this reporting, they asked the IEA, OECD, Organization of Petroleum Exporting Countries, and World Bank to undertake their own assessments of the impacts of fossil fuel subsidies. The scope of such assessments envelops examining the level of subsidization, proposed reforms, and, critically, the aggregate economic, energy, and environmental impacts of those subsidies. In parallel, the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP) process has catalyzed in better reporting and analysis of subsidy impacts.⁹⁴ As of November 2015, 39 countries had submitted analysis of energy and fossil fuel subsidies (and some of their consequent impacts) as part of their Intended Nationally Determined Contributions (INDCs) examined in advance of COP 21 in Paris, France.

Going beyond these efforts, one innovative option is a Public Registry of Basic Information About Subsidies. This concept bears some similarity to the Public Registry of Natural Resource Stock Depletion (and other forms of natural resource accounting) advocated as an improvement to Gross National Product calculations.^{95 96 97} This registry, managed by local and national governments, could track and register the manner in which subsidies are implemented, who has jurisdiction over them, their annual cost, and citations to relevant legal authorities. Regulators could consider subsidies that do not appear on the registry null and void after a certain period, forcing all departments and ministries to reveal a complete set of costs.⁹⁸

In parallel would be Subsidy Justification Analyses defending any subsidies on the registry deemed beneficial enough to be considered for renewal.⁹⁹

Implementing adjustment packages

Another pragmatic solution is to provide adjustment packages for those most harmed from subsidy removal—an action that undercuts some of the political opposition against the elimination of subsidies. For instance, if one is cutting back a subsidy for offshore deepwater oil and gas platforms, the funds gained could be used to help train the soon-to-be unemployed workers in other skills, or provide them with medical insurance or unemployment benefits for an extended period of time. Though outside of the energy sector, the Australian dairy industry, for example, relied on an adjustment package funded by subsidy removal which gave technical assistance to farmers wishing to leave the industry, and grants to communities where dairy was central to local economies.¹⁰⁰

Similarly, the German federal government and state of North Rhine-Westphalia removed their subsidies for coal exports over a twelve-year period of 1997 to 2008, phasing in reductions slowly so that subsidies shrunk from €4.73 billion to €2.38 billion with a complete removal scheduled (though not guaranteed) for 2018. Proceeds from some of the saved revenues were put into an adjustment package for miners that had lost their jobs. The result of the removal included a reduction in operating mines from 19 to eight, a reduction in production from 46 million tons to 26 million tons, and the number of mining jobs reduced from 78,100 to 38,500, though for most the retraining was successful and they were able to find employment in other sectors.¹⁰¹ Across the United Kingdom, coal miners in the 1980s were offered large “redundancy payments” in ballots organized by the National Coal Board, and these offers were accepted even at the most militant pits who were opposed to government plans. Subsidy reform packages

introduced by Iran, Namibia, the Philippines, and Turkey also had similar compensating measures to affected stakeholders, and no less than eight other national instances of reform relied on targeted cash transfers to vulnerable groups.¹⁰²

Learning from successful case studies

Though rare, energy subsidy removal has been done successfully before. Several European states depicted in Table 5 repealed reduced value added tax (VAT) rates to coal, fuel oil, natural gas, and electricity providers over the previous three decades. These artificially low VAT rates had been implemented to benefit poor households—similar to low VATs given on other “basic needs” such as food. However, the VAT subsidies were eliminated when it was discovered that most of their benefits went to the rich, rather than the poor, since the wealthy tended to consume more energy, and that removal had only a negligible impact on energy market prices but saved drastic amounts of tax revenue for the governments involved.¹⁰³

Table 5: VAT Energy Subsidies Removed in Europe, 1983-2005

Country	Type of subsidy removed				Year(s)
	Coal	Fuel Oil	Natural Gas	Electricity	
Austria	X	X	X	X	1983
Belgium		X	X	X	1980 to 1983
Czech Republic	X	X	X	X	1994 to 1997
Greece	X	X	X		1992 to 1998
Hungary		X	X	X	2003 to 2005
Italy		X	X		1984 to 1988
Poland	X	X	X	X	1998
Portugal		X			1996 to 2001
Slovakia	X	X	X	X	2003

Source: Modified from European Commission, *Reforming Environmentally Harmful Subsidies* (UK: Institute for European Environmental Policy, March, 2007).

The author's own compilation of successful subsidy energy reforms is offered in Table 6. These examples cover 25 countries over the past sixty years. Their efforts do suggest that subsidy removal and reform can bring substantial positive impacts on energy prices or national economic development. As a drawback, a key issue on the all of the subsidy reform examples is whether changes are observed effects of limited policy change or falling world reference prices, or whether laws were actually changed to prevent backsliding. And while adjustment packages may have worked for Western Europe and countries such as those in Table 6, complementary policies may need a totally different approach for countries like Angola, Nigeria, or Venezuela, which are not on the list.

Table 6: Successful Examples of National Subsidy Reform, 1952 to 2016

Country	Year(s)	Energy Source	Description/Result
Armenia	1994	Electricity	Scaled back electricity subsidies by 22 percent of GDP from 1994 to 2004
Brazil	1990-2002	Oil and gas	Lowered subsidies for oil and gas from 0.8 percent of GDP to revenue generating in 2002
Brazil	1993-2003	Electricity	Lowered subsidies equivalent to 0.7 percent of GDP
Chile	1995	Coal	Removed its subsidies after it became apparent that coal production prices were extraordinarily high (\$95 per ton) compared to other countries (\$54 in Brazil, \$52 for the United States). The removal actually raised incomes by almost 1 percent among all Chilean households and cut emissions of carbon dioxide and particulate matter by nearly 8 percent
China	2015	Oil and gas, electricity	To advance the reform in the pricing and taxation regime for energy- and resource-based products, China plans to revoke selected fossil fuel subsidies so that emissions drop 0.78% per year by 2020
Egypt	2014	Oil and gas, electricity	Policy is implemented using four pillars, namely: set different prices for petroleum products based on energy generation efficiency; increase the efficiency of energy use; provide support to certain sectors to promote switching from conventional energy sources to clean energy sources; and apply the fuel subsidy smartcard system to ensure that subsidies are received

			by target beneficiaries. Projected to reduce emissions by 14.88% by 2020.
Ghana	2005	Oil and gas	Removed subsidies to the degree that they realigned the price of energy by 50 percent
Indonesia	2005-2009, 2013	Oil and gas	Subsidies declined from 3.5 percent of GDP in 2005 to 0.8 percent in 2009, though they increased recently in 2013 due to protests
Jordan	2005-2012	Oil and gas	Gradually removed all fossil fuel subsidies by 2008, resulting in price increases ranging from 16% for gasoline to 76.5% for LPG. Energy subsidies declined from 5.8% of GDP in 2005, to 2.6% in 2006, to 0.4% in 2010 while in November 2012 the government of Jordan announced that it had removed the remaining subsidies on oil products
Iran	2010	Oil and gas	Reduced annual growth in the national consumption of petroleum products to zero
Kenya	2001-2008	Electricity	Subsidies dropped from 1.5 percent of GDP in 2001 to 0 percent in 2008
Mauritania	2011	Oil and gas	Subsidies declined from 2 percent of GDP to close to zero in one year
Morocco	2015	Electricity	Has carefully reformed subsidies whilst at the same time expanding investment into renewable energy through ambitious targets and to people through the development of a national safety net. Carbon emissions expected to decline 6.6% by 2030
Namibia	1997	Oil and gas	Removed subsidies equal to about 0.1 percent of GDP
Niger	2011	Oil and gas	Removed subsidies equivalent to 0.9 percent of GDP
Nigeria	2011-2012	Oil and gas	Subsidies declined from 4.7 percent of GDP to 3.6 percent of GDP
Peru	2010	Oil and gas	Lowered subsidies for petroleum equivalent to 0.1 percent of GDP
Philippines	1996	Oil and gas	Government successfully removed energy subsidies equivalent to 0.1 percent of national GDP
Philippines	2001-2006	Electricity	Subsidies dropped from 1.5 percent of national GDP to 0 percent
Poland	1998	Coal	Forced the coal sector to improve its efficiency and substantially reduced fiscal transfers
South Africa	1952-1957	Oil and gas	Successfully avoided subsidies and still secured energy supply
Turkey	1998	Electricity	Removal of fossil fuel subsidies put competitive pressure on electricity suppliers and turned their net losses into profitability
Uganda	1999	Electricity	Subsidies declined equivalent to the amount of 2.1 percent of GDP

United Arab Emirates	2014	Oil and gas, electricity	Has introduced a new fuel pricing policy, which will put the UAE in line with global prices to support the national economy, lower fuel consumption and protect the environment. Fossil fuel subsidies will decline 14.41% by 2020
Yemen	2005-2010	Oil and gas	Subsidies dropped from 8.7 percent of GDP in 2005 to 7.4 percent in 2011

Source: Compiled by the author from International Monetary Fund 2013; United Nations Environment Program, *Energy Subsidies: Lessons Learned in Assessing Their Impact and Designing Policy Reforms* (New York: UN Foundation, 2004); Laura Merrill and Vivian Chung. 2015. *Financing the Sustainable Development Goals through Fossil-fuel Subsidy Reform: Opportunities in Southeast Asia, India and China* (Manitoba, Canada: IISD); Anika Terton, Philip Gass, Laura Merrill, Armin Wagner and Eike Meyer. *Fiscal Instruments in INDCs: How countries are looking to fiscal policies to support INDC implementation* (Manitoba, Canada: International Institute for Sustainable Development, December 2015); and Laura Merrill, Andrea M. Bassi, Richard Bridle and Lasse T. Christensen. *Tackling Fossil Fuel Subsidies and Climate Change: Levelling the energy playing field* (Oslo: Norden, 2015).

Recognizing political economy

Subsidy reform by itself has its own set of risks, and it must be designed to ensure that winners are maximized and losers minmaxed. Reform must also ensure that the poor or vulnerable are not further marginalized. Beaton et al. note that risks to subsidy reform include short-term shocks to national GDP, rises in inflation, and reductions in international competitiveness of fuel-consuming sectors such as energy, agriculture, and transport.¹⁰⁴ If subsidy benefits were directed primarily at poor households, then their removal can have a regressive effect, lowering income. It can also create increases in poverty when subsidy removal results in unemployment associated with affected business sectors. Merrill and Chung note that:

In the process of moving towards fossil-fuel subsidy reform, it is necessary to shift away from universal welfare programs based on discounted fossil fuels and towards the implementation of long-term targeted social welfare programs in health, education and assistance to the poor Temporary cash transfers or other compensation policies may also be needed to mitigate the impacts of rising fuel prices within the population directly,

depending on the fuel in question and the impacts that higher prices will have on low income and vulnerable groups.¹⁰⁵

In extreme cases, subsidy reform and removal can result in violent, social conflict. In 2012, for example, Nigeria removed subsidies on petrol and diesel worth about \$8 billion per year, and consequently retail prices doubled almost overnight.¹⁰⁶ There were immediate protests on the streets of Nigeria's major cities, and these quickly escalated into violence. Similar violent conflicts related to reductions in fossil fuel subsidies have also occurred in India, Indonesia, Jordan, and Sudan.

For these reasons, the political economy dimensions to subsidy reform need more attention. These political economic challenges can involve a range of factors, including:

- Potential hardship on the poor and vulnerable who might be heavily dependent on the subsidies, particularly in the case of kerosene or gas;
- Influential stakeholders, especially fossil fuel subsidies that benefit the upper and middle classes and industry disproportionately;
- Macroeconomic impacts, such as the inflationary effect reforms can have on energy prices and cost increases being passed onto consumers;
- Reduced competitiveness and higher fuel and electricity prices may necessitate costly energy-efficiency investments, affecting costs and output in manufacturing;
- Structural shifts that may result from the loss of competitiveness of energy intensive industries may cause job losses and reductions in employment;
- Poor households can be forced to substitute or shift to inferior fuels because they are cheaper, with sobering health and environmental impacts;

- Governance, accountability, and service quality can also decline if subsidies were a lifeline to ensuring basic maintenance and operation of energy systems.¹⁰⁷

Crucially, the above adverse effects (and associated political challenges) will vary significantly depending on the type of subsidy. In a review of 22 case studies of subsidy reform, the IMF found that only in 12 cases did reform efforts not cause some type of significant economic or social disruption.¹⁰⁸

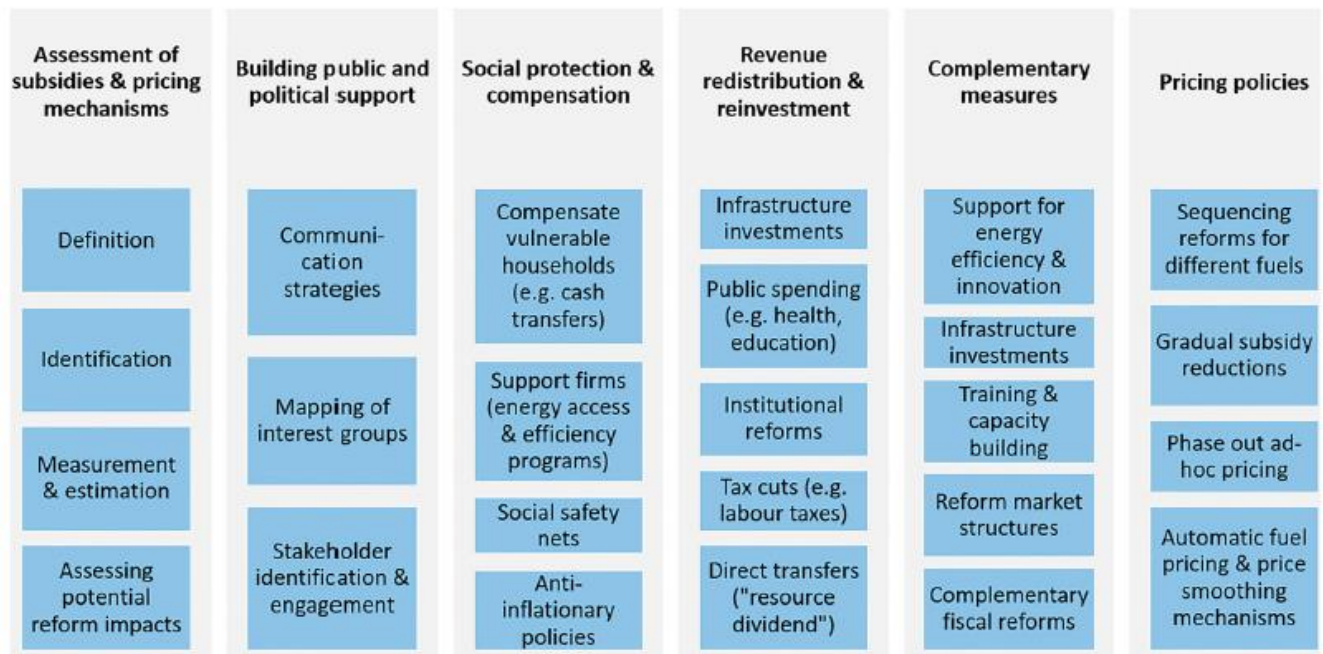
Conclusions and future research

Ultimately, the hidden toll that energy subsidies can take on social welfare, economic growth, and even technological innovation needs to become more visible. Best practices in subsidy measurement and data collection, subsidy impact studies, and adjustment packages offer local and national planners a set of tools they can calibrate to decide on whether particular subsidies ought to be reformed or simply eliminated. However, reforms are more likely to be successful in periods of political or social change and crisis, or when national goals align with those of regional bodies such as the European Union. Moreover, mitigating measures for subsidies ought to be built-into policy packages at the outset, given that subsidy reforms will always generate some losers.¹⁰⁹

Thus, we need a more complete energy subsidies research agenda that includes continual work on updating best practice methodologies in measurement and valuation alongside efforts that look at politics, social protection, revenue distribution and reform strategies. Rentschler and Bazilian thoughtfully propose such an agenda in Figure 4.¹¹⁰ That agenda includes enhanced understanding about the determinants of successful reforms. Concrete country-level studies for all major subsidizing economies are warranted and potential price shocks need to be understood with respect to their variability across income groups, geographical locations, and occupations.

The evidence and consequent public awareness has been disproportionately focused on consumption subsidies, whereas producer subsidies – particularly in developed countries – remain insufficiently researched and reformed. There is also a need to evaluate the role of subsidy reforms as part of comprehensive climate change policy packages, and as a tool for deep emissions reductions.

Figure 4: Elements of an Integrated Research Agenda on Global Energy Subsidies and Subsidy Reform



Source: Jun Rentschler & Morgan Bazilian (2016): Reforming fossil fuel subsidies: drivers, barriers and the state of progress, Climate Policy (in press 2016).

Critically, and lastly, is to keep a focus on political economy. We must keep the politics underlying both subsidy implementation and subsidy reform in view. We must also keep in mind that it is, as Lockwood puts it, “precisely in those countries in which subsidies need the most reform where the credibility of the general reform intention and of specific reform strategies is the weakest.”¹¹¹ This suggests new research questions around the topic of “second-best” or “hybrid” reform strategies, the achievable over the possible, the pragmatic over the

perfect. Subsidies can be blunt instruments that result in wide-ranging social, economic, and environmental repercussions. It should come as no surprise that their repeal also creates similar drifts, currents, and ruptures that we are only beginning to comprehend.

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